

Urea Super Granule (USG) as Key Conductor in Agricultural Productivity Development in Bangladesh

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Abstract

The deep placement of large urea granules (known as Guti urea in Bangladesh) into puddle enhances the soil's nitrogen absorption capacity. It helps nitrogen to stay close to the roots of paddy plants, preventing urea from being washed away by rains or floods. Urea Super Granule (USG) technology is cost effective and environment friendly. Ministry of Agriculture (MoA) with technical assistance from the International Fertilizer Development Center (IFDC) has been implementing the Guti Urea Technology Extension Project in the country since November 2007. Study says, cultivated lands using Guti urea get three times better result than the lands cultivated by urea sprayed by hand in the traditional method and earn good amount of profit and normal fertility of the land may shrink faster with the use of Guti urea instead of using organic compost fertilizer. This technology is not new in Bangladesh now but due to some gaps i.e., lack of proper marketing and demonstration, subsidy in fertilizer (especially to promote USG), less availability of user friendly Urea Deep Placement (UDP) applicator and communication gap between farmers and officials became some major constraints. In this study, author tried to focus on total scenario of Bangladesh agriculture highlighting UDP technology as productive agricultural input. Comparing with field survey data and it has been found that the technology not yet been popular to the farmers due to some technical problems like high labor cost, time consuming and difficult application process. To solve these problems it is suggested that, necessity of active marketing to spread the technology to the farmers is very important, also create more demonstration project, available supply of USG, active co-operation from fertilizer dealers can be a major support to achieve this technology as successful.

Keywords: Bangladesh, USG, FDP, UDP, Agricultural Policy, Agriculture

1. Introduction

Bangladesh is one of the largest deltas of the world with a total area of 147,570 sq. km. With a unique communal harmony, Bangladesh has a population of about 150.6 million making it one of the densely populated countries of the world. The economy of Bangladesh is predominantly on agricultural. Since the birth of Bangladesh, the country has achieved an incredible growth in food production and reached towards self-sufficiency by the year 1990. About 80% of the total population lives in rural areas, and 62% of them are directly, and others are indirectly engaged in a wide range of agricultural activities. Agriculture, of course, is the main source of income and employment in rural areas; indeed, in poorer countries it is often the principal employer in the entire economy. Cereal crops, predominantly rice, are the mainstay of Bangladesh's agriculture. In recent years, with the spread of irrigation and the adoption of high-yielding varieties (HYVs), fertilizer, and other agricultural inputs, rice has become an even more important crop for Bangladesh, as a source of both food and income for farmers. Agricultural growth is also the main way to reduce poverty, in both rural and urban areas. Poverty alleviation is universally recognized as proper concern, indeed a responsibility, of policy.

It is important to examine the existing status, policies, and institutional structures related to agricultural input sectors to examine their impact on the trajectory of growth. This is necessary in order to arrive at an understanding of the challenges and limitations of existing policies that might serve to hinder agricultural growth in Bangladesh. With this objective, this paper examines the key agriculture input sector - fertilizer, agricultural equipment, research and extension drawing upon primary data, numerous secondary sources, policy documents, and data from Bangladesh Bureau of Statistics, Ministry of Finance, Ministry of Agriculture.

2. Background of Bangladesh Agriculture

Agriculture is one of the drivers of growth of Bangladesh economy. The contribution of agriculture sector to GDP stood at 19.29% (BBS provisional estimate) in FY 2011-12 (MoF, 2012). According to the estimation of Bangladesh Bureau of Statistics (BBS), the overall contribution of the broad agriculture sector at constant price was 20.01% of GDP in FY 2010-11. The growth of broad service sector, particularly the growth of wholesale and retail trade, hotel and restaurants, transport and communication sector is strongly supported by the agriculture sector. Besides, around 47.30% of the total labor force of the country is engaged in agriculture sector (MoF, 2012).

Figure 1 represents the sectoral share of GDP at constant prices (Base Year: 1995-96). The figure shows that, the share of the agriculture and forestry sector in GDP at constant prices was 14.90% in the FY 2011-12 which was 15.58% in FY2010-11. The contribution of all the three sub-sectors of agriculture and forestry sector decreased during this period. Similarly the contribution of fisheries sub-sector marginally slid down from 4.43% in FY2010-11 to 4.39% in FY2011-12. The overall contribution of broad agriculture sector dipped to 19.29 in FY 2011-12 which was 19.29 % in FY2010-11.

During FY 2011-12, within the industry sector, GDP growth at constant prices in mining and quarrying sub-sector remained similar to the previous year's growth of 1.26%. Contribution of manufacturing sector expanded to 19.01% of GDP in FY2011-12 compared to 18.42% of the previous fiscal year. The share of power, gas and water supply and construction sector also increased during this fiscal year compared to the share recorded a year earlier. On the contrary, the share of broad industry sector reached to 31.26% in the current fiscal year, from 30.38% of FY 2010-11.

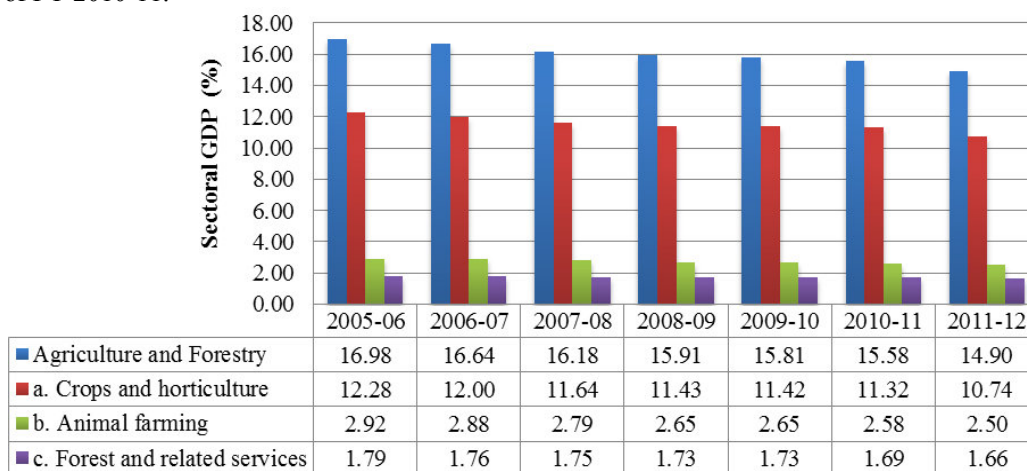


Figure 1: Sectoral share of GDP (%) at Constant Prices (Base Year: 1995-96)

Source: Bangladesh Economic Review 2012

The agricultural economy at independence was moreover growing only slowly; yields of rice, by far the main food crop, had risen just 1.5% a year from 1959 to 1971 (Hossain, 1988). Agricultural share has been declining over the years in Bangladesh. Figure 2 show that, the share of agriculture to GDP has declined from 32.77% in 1980-90 to 26.43% in 1991-2001 and 19.71% in 2002-2012.

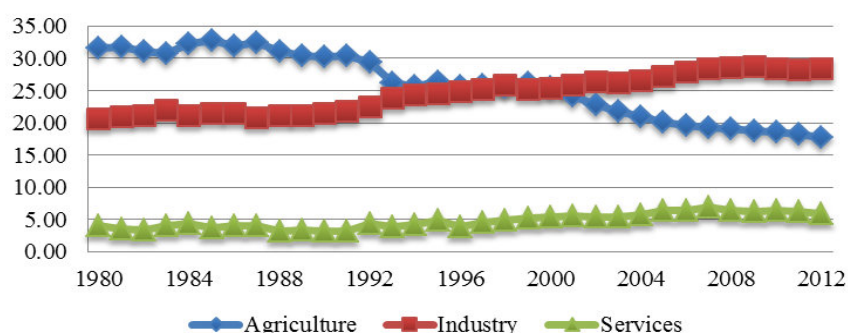


Figure 2: Sectoral growth GDP at constant price

Source: Author, based on World Bank - World Development Indicator

Despite steady progress towards industrialization, agriculture remains the most important sector in Bangladesh. About 19.29% of Gross Domestic Product (GDP) of the country comes from agriculture sector and 13.44% of GDP comes from crop sector itself (MoA 2014). Besides, it has indirect contribution to the overall growth of GDP. Many sectors included in broad service sector such as wholesale and retail trade, hotel and restaurants, transport and communication are strongly supported by the agriculture sector. This sector also provides employment for around 47.3% of the total labor force and seems to have managed to feed around 150.6 million people of the country (MoF 2012). During the last decade, significant changes took place in agriculture sector which include, among others, new production structure, use of high yielding varieties supported by fertilizers, pesticides, mechanized cultivation, irrigation etc. All these changes have contributed much to the increased production of food grains. The development of agriculture sector is very much urgent for poverty reduction, food

security and sustainable development of our country.

3. Agricultural Policies in Bangladesh

According to Norton (2004), agriculture is not an island in the economy; its ultimate objective should be to support national development. In agriculture, as in other areas, economic policy responds to national imperatives and to a social and political vision. It is designed to promote the achievement of societal aims that are not exclusively economic in character. Therefore, the basis of a strategy, or set of policies, should be the enunciation of broad social, or societal, goals for agricultural and the rural sector. Fundamentally, they should be related to the promotion of human development. Specific objectives for the agricultural sector can be derived from this overarching goal.

The importance of the agriculture sector has long been recognized by the Government of Bangladesh. Ministry of Agriculture (MoA) has launched a range of development projects and programs in the agriculture sector in the line of National Agriculture Policy formulated in 1999 as the first comprehensive document prepared by the Ministry since the country's independence since 1971. Also, an action plan is in place for achieving goals and objectives articulated in the National Agriculture Policy.

The National Agriculture Policy (NAP) broadly aims at creating an enabling environment for sustainable growth of agriculture for reducing poverty and ensuring food security through increased crop production and employment opportunity as envisaged in National Strategy for Accelerated Poverty Reduction (NSAPR), Millennium Development Goals (MDGs) and South Asian Association for Regional Co-operation (SAARC) Development Goals (SDGs).

NAP has an overall objective, 18 subsidiary objectives and 18 program areas. The overall objective is: *"to make the nation self-sufficient in food through increasing production of all crops, including cereals, and ensure a dependable food security system for all."*

The specific objectives are to:

- Developing and harnessing improved technologies through research and training;
- Increasing productivity and generating income and employment by transferring appropriate technologies and managing inputs;
- Promoting competitiveness through commercialization of agriculture; and
- Establishing a self-reliant and sustainable agriculture adaptive to climate change and responsive to farmer's needs.

Chemical Fertilizer is one of the main inputs required for increasing crop production. The expansion of modern agricultural practices together with intensified cultivation has led to an increasing demand for fertilizers. As a result of unbalanced use of fertilizers, the fertility of land is declining on the one hand and the potential yield is not achieved on the other. In this respect, it is extremely important to adopt and implement such policies so as to encourage the farmers in using balanced fertilizers and at the same time protecting the soil fertility. As a broad principle of fertilizer use, a sustained increase in the productive capacity of land and its preservation in the long run will get priority over the immediate yield improvement. In order to strengthen fertilizer management, several policies have been taken by the government of Bangladesh. One of the policies is adequate production of Gutti (USG), use and implementation method.

Also Government of Bangladesh has promulgated a number of acts, rules to increase availability of quality fertilizers. Those rules and acts have some limitations and gaps:

- Fertilizer Act, 2006 and Fertilizer Rules, 2007 provided outline and procedures for fertilizer quality management and standardization without substantial instruction for quality control, analysis, fertilizer ingredients and the standard of laboratories.
- MoA fixed specification for major fertilizers through a notification, but not specified limit of the presence of heavy metal and physical impurity.
- The Fertilizer Management Act, 2006 and subsequent modification of Fertilizer Rules in 2007 provides some guidelines and procedures for fertilizer quality management and standardization, but not provided substantial instructions on fertilizer quality analysis, fertilizer ingredients and the standard of laboratories.
- The amended Fertilizer Rules, 2007, provided some guidelines for fertilizer inspection but method of inspection and support of portable analytical facilities essential to detect the permissible level of contamination is not provided.

According to the World Bank²⁰, use of quality agricultural inputs such as seeds, fertilizers, pesticides, farm equipment, and irrigation is critical to promote diversification, and increase productivity. However, despite major improvements, agricultural inputs continue to experience problems such as lack of timely availability, poor quality, and high price that are even more marked in remote rural areas. World Bank also suggested that, a

²⁰ World Bank - Bangladesh: Priorities for Agriculture and Rural Development

need to examine the impact of input price policy and subsidies on profitability and competitiveness, and explore options for their reform.

4. FDP/UDP - a win-win technology in Bangladesh

Plant nutrients are essential for cultivation of crops. Among the nutrients, nitrogenous fertilizers urea is widely used by millions of rice farmers across the globe both for irrigated and rain-fed rice for its large requirements and instability in soil. The efficiency of nitrogen fertilizer especially urea is very low in rice but urea is the principal source of nitrogen for rice in Bangladesh agriculture. This important element has been found to be deficit in most agricultural soils in Bangladesh. (Miah, I. et al., 2012).

Prilled urea (PU) is the most commonly used nitrogenous fertilizer for rice cultivation in Bangladesh and many farmers still practicing broadcasting method of urea application to fertilize paddy plants which is highly inefficient – about two-thirds of the fertilizer is lost as greenhouse gas or becomes a groundwater pollutant.

Fertilizer Deep Placement (FDP) is an innovative, proven fertilizer application technology that achieves average yield increase of 18% while reducing fertilizer use by about one-third²¹. The new technology is being followed in Bangladesh, which ensures 40% more efficiency of urea utilization.

International Fertilizer Development Center (IFDC) jointly with Bangladesh Ministry of Agriculture (MoA) through the Department of Agricultural Extension (DAE) developed FDP technology based upon USG (when used with urea fertilizer, FDP is called UDP – Urea Deep Placement). UDP is the insertion of large urea briquettes (called "Guti" in Bangladesh) is a simple but a very effective technology which involves the placement of 1-3 grams of USG or briquettes at a 7-10 centimeters (cm) soil depth shortly after the paddy is transplanted. UDP increases nitrogen use efficiency because most of the urea nitrogen stays in the soil, close to the plant roots where it is absorbed more effectively. The benefits of the technology are significant – a 20% increase in crop yields and a 40% decrease in nitrogen losses²².

According to IFDC, FDP consists of two key components. The first is a fertilizer 'briquette,' produced by compacting commercially available solid fertilizers. The second key component of FDP is the placement of briquettes below the soil surface. When used to fertilize irrigated rice, briquettes are centered between four plants at a depth of 7-10 centimeters within seven days after transplanting. Placement is done either by hand or with a mechanical applicator. The briquette releases nitrogen (N) gradually, coinciding with the crop's requirements during the growing season. In this technology, the granular urea is compressed in small machines and the size of it is made 1.8 grams and 2.7 grams. Ali (2011) stated that, in the year 2011 in Boro season, IFDC introduced UDP technology in 68 upazilas²³ (sub-district). For each hectare, 170 kilograms of Guti urea (USG) was used, which is about 30 to 40% less than that of granular fertilizer and it has been observed that, the crop yield in the Guti plots per hectare 300 to 2,400 kilograms more than that of the fields where granular urea was broadcasted.

USG *per se* is not an efficient nitrogen fertilizer, but the proper deep placement of USG in transplanted rice makes it agronomically efficient (Savant and Stangel, 1990). They also argued that in using USG, consideration of the following factors should help to ensure agronomic efficiency of deep-placed USG and increase the chances of obtaining additional yield.

1. **Soil factors:** Only use in soils having a low water percolation rate and a CEC ≥ 10 meq 100 g⁻¹ soil.
2. **Plant factors:** Give preference to short to medium duration dwarf rice varieties. For the long duration variety, basal deep placed USG with a suitable topdressing of N as PU at panicle initiation stage would be helpful.
3. **Management factors:** Apply basally 30 to 60 kg USG-N ha⁻¹ using only USG of the right weight (1-2 g urea granule⁻¹). Place one super granule for each four hills at 7-10 cm soil depth using the right plant population and modified spacing. Use modified 20 cm x 15 cm or 20 cm x 20 cm spacing to facilitate efficient placement of USG by hand or machine. Workers should always use the so called traffic lane of the modified spacing for performing all post transplanting field operations. When deep placement of USG is delayed after transplanting, extra care is necessary to close the holes left at the placement sites. When puddling is inadequate or improper and deep placement is done during transplanting, some care may be required to close the holes.

The overall nitrogen transformations and transport processes occurring at and near the deep placement sites of USG are shown schematically in Figure 3

²¹ International Fertilizer Development Center (IFDC) – About FDP

²² Development Matters – Urea Deep Placement Technology <http://goo.gl/jpQYbg>

²³ Upazila (sub-district) - an administrative unit equivalent to a county

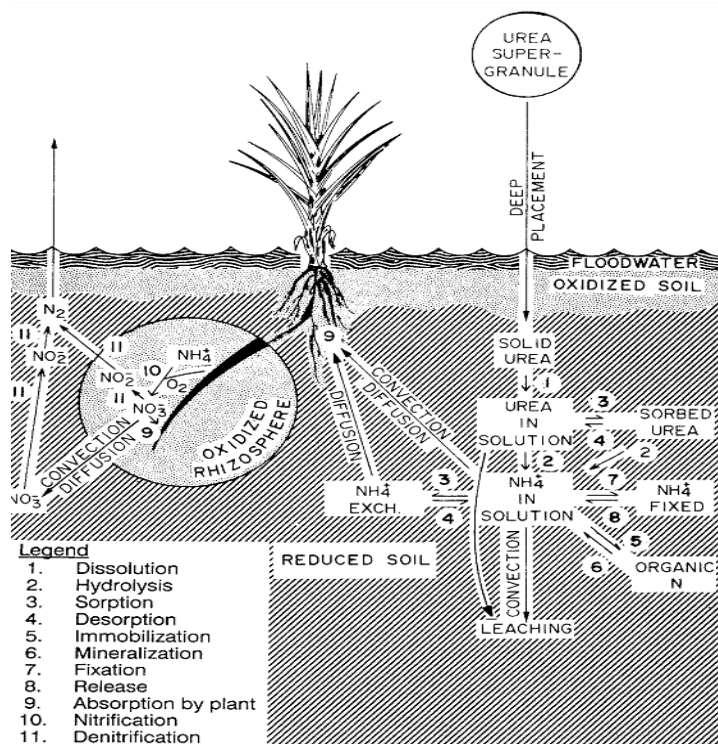


Figure 3: Overall nitrogen transformation and transport of deep placed USG N in a planned submerged rice soil
Adopted from: Savant, N.K. & Stangel, P.J. (1990)

5. Constraints of using USG and its future in Bangladesh agriculture

USG is applied by hand, which is a very time consuming and laborious job. Yet many farmers in different parts of the country use this technology to get more yields with less fertilizer. International Fertilizer Development Corporation (IFDC) has been trying to popularize the USG technology in different countries for many years. They became successful to some extent. But due to lack of a good applicator, the technology could not be popularized to the desired level (Roy 2010).

Farmers of Bangladesh have been applying Guti (USG) urea to their crops for increased yield and low production cost since 1980s (Palma 2013). It was applying by hand but there was some numerous problems arise like high labor cost and suffer agonizing back pain as farmer's need to bend down to apply Guti urea also major constrains is too much time consuming due to its application by hand. During the early 1980s, scientists at the International Rice Research Institute (IRRI) in the Philippines were developing and testing several applicators (Khan et al., 1984). But now there is hope to overcome this problem. A scientific invention of Guti (USG) applicator reduce the labor cost and farmers woes in applying Guti urea and not only that, it's easy to use and time saver. A hand operated USG applicator has been developed by Bangladesh Agricultural Research Institute (BARI). The new Guti Urea Applicator developed by IFDC, based on previous models invented by Bangladesh Agricultural University (BAU) and Bangladesh Agricultural Research Institute (BARI).

This is two-row machine that applies USG at 6-7 cm depth below the soil surface in the middle of four bunches or rice seedlings. When USG is applied by hand, 28 hours are required per hectare, whereas only 10 hours are required by the applicator. The cost of application is proportionally reduced. The biggest advantage of the applicator is the reduction of drudgery. It is expected that, if proper publicity is made and the farm machinery manufacturers come forward in the production of quality machine, then the applicator will be popular among farmers very soon. In turn urea requirement and production cost will be reduced and rice production will be increased.

Urea Super Granule which is known as Guti urea in Bangladesh still not yet popular to the farmers as well as its application process. To do the research about this agricultural new input technology, a field survey held with 100 farmers in two upazilas (sub-district) in Mymensingh district and two upazilas (sub-district) in Rangpur district. 51 farmers (100%) from Mymensingh district know about this fertilizer where as in Rangpur district, among 49 farmers, 88% of farmers know and 12% does not know any information about USG.

To find out source of information about USG a question asked to the respondents and in Mymensingh district, 82% respondents mentioned DAE extension agent as main source of information, 67% of respondents observed neighbors field using USG, 61% knows from demonstration site and 16% respondents got information about USG from fertilizer dealers. Whereas in Rangpur district, 49% of respondents got information about Guti from

DAE extension agent, 27% of respondents from demonstration site and most interestingly 49% of respondents got information from television media, 8% of respondents from farmers meeting (Figure 4). From the survey it has been found that, DAE agent, demonstration site, fertilizer dealers, farmers engaged and used in their fields, television media are as the main sources of information. Also observed that newspaper and print media, electronic media like television and radio, banner/billboard, open announcement in public places and also fertilizer dealers could be involve more to this new agricultural input. Local NGOs and agricultural office in local area need to involve more.

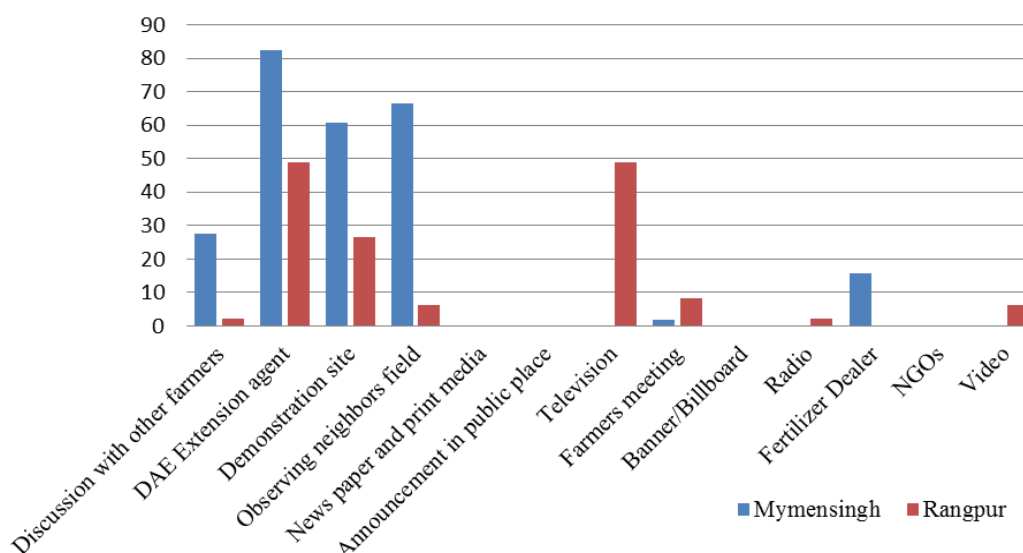


Figure 4: Source of information about USG (% of respondents)
Source: Author, based on field survey data

The respondents who have heard about USG (Guti) from different sources (which have mentioned earlier), a question was asked about using of Guti and among total 100 respondents from two districts, 54% replied with yes and 46% replied with no. Particularly, in Mymensingh district 55% of respondents used Guti and 45% did not. And in Rangpur district 37% of respondents used Guti and 63% did not (Table 1).

Table 1: USG user (total % of respondents) in field survey area

Survey area	% of respondents	
	Yes	No
Mymensingh	55	45
Rangpur	37	63
Total	46	54

Source: Author, based on field survey data

Total 46% of respondents never used USG in their field and author was trying to find out the reason for not using and surprisingly 60% of respondents said there is not enough information about Guti and basically they are lack of knowledge about this fertilizer. 21% of respondents complained this fertilizer using requires more labor, 12% replied as USG application is physically difficult, 4% replied USG supply not available, 2 % said about high price. So from the survey it is clear to understand that farmers are aware of information about USG, requires more labor and application is physically difficult (Figure 6)

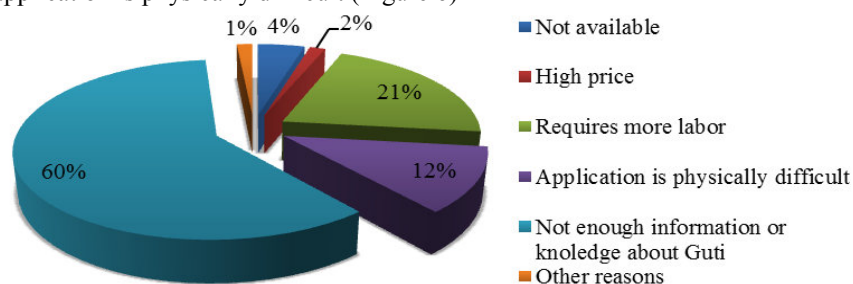


Figure 6: Reasons for not using USG

Finally, a supplementary question also asked to the farmers to get the result about using USG (Guti urea) where

as other fertilizers like prilled urea, DAP available in market. Among the Guti urea (USG) user, 48% of respondents said it has good result, 47% of respondents got this as profitable and 5% of respondents said low price is also a reason to use USG in the fields (Figure 7).

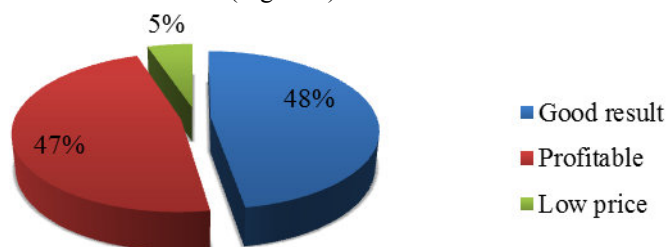


Figure 7: Reasons for using USG (% of respondents)

From the survey data, it is clear to understand that the farmers who know about the Guti urea are aware of proper knowledge about its application, those who knows they are not confident enough due to its difficult application. Significantly motivation is very much important with the technical support from the government as well as NGOs.

6. Conclusion

The UDP technology, which is new in Bangladesh, been practicing since introduced to the farmers. With difficulties farmers of Bangladesh were trying to make it sustainable but due some technical problem like complex implementation of USG and lack of proper marketing and promotion, the technology not yet been introduced to the majority of the farmers, in a word can say "*not user friendly*". To make it happen Government of Bangladesh (GoB) with the support of bilateral development agency like USAID and nonprofit public international organization like IFDC, has taken numerous strategy like invention of user friendly and effective device to implement USG. The Bangladesh Ministry of Agriculture (MoA) asked Bangladesh Agricultural Research Institute (BARI) and Bangladesh Rice Research Institute (BRRI) to develop the applicator. BARI and BRRI developed push-type applicators, while Bangladesh Agricultural University (BAU) developed an injector-type one. Unfortunately those, however, were not handy enough for the farmers.

Department of Agricultural Extension (DAE) needs to spread the UDP technology to the farmers in each corner of Bangladesh and that's the way it can be sustainable in a dynamic sense – i.e., continuation of practice as development of agriculture. Audio-visual and print media needs to pass this information to all farmers. Also all agriculture officials should be trained on properly on it and demonstrate to the farmers. However, Bangladesh can be a leader in USG use and it's possible only through Government of Bangladesh (GoB). Particularly Ministry of Agriculture (MoA) needs to promote USG, provides a good laboratory to identify and to address whatever questions emerge as more farmers adopt USG. Expansion of USG will ensure food security through increased production, not only at the household level but also at the national level, allowing Bangladesh to reach rice self-sufficiency in the near future and thus agricultural productivity gain can be a boon for the Bangladesh.

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